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ATOMIC WEAPON DATA
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total of 42 mCi. One objection to this source is that the same energy gamma is emitted by some weapon components. However, it would require approximately 400 kg of thorium, for example, to provide the same intensity gamma-ray source. Such a large amount of thorium is unlikely.

Because the detector is fixed for each scan, the background introduced by the system under inspection can be accurately measured and subtracted from the response caused by the external source. Naturally, some loss in accuracy results from counting statistics.

Scattered gamma rays are degraded in energy. Therefore, if the source consists of a single high-energy gamma ray, and if the detector has adequate energy resolution, scattered events are rejected. The dynamic range of the technique is simply the gamma-ray attenuation factor, which can be detected above background. With a NaI detector, a dynamic range of 1000 is routinely observed, which is the attenuation introduced by about 3 in. of uranium. A Ge(Li) gamma detector possesses higher resolution, and as a result a larger dynamic range is possible. However, the gamma detection efficiency is low. Thus, if observation time is limited, the increased efficiency of a NaI detector is desirable even at the expense of poorer energy resolution.

The overall spatial resolution is not precise and is controlled in part by the physical size of both the source and detector and in part by the scan rate. Since the data are taken essentially point by point, the total quantity of data is restricted by any reasonable inspection time limitation.

2. **Developmental Results.** During the accelerated program, a large number of gamma transmission scans were made on a wide variety of nuclear warheads. The presentation here is limited to some examples demonstrating the results achievable on those operational U.S. weapons systems specifically designated in the scope of work. The data are presented generally as transmitted intensity (counts/channel) as a function of source position (channel number). Thus, low intensities represent regions of high opacity (integrated μx) between source and detector.

Figure 54 displays a scan along the axis of the W62.

Figures 55 and 56 are scans of the W53, which is the single warhead deployed on the Titan II. This operational U.S. weapon is considered representative of the weapon design expected in large Soviet systems such as the

b(1)

Fig. 54.
Gamma transmission scan along the axis of the W62.

Gamma transmission scans were made of several different multiple systems, each consisting of three warheads; however, the extension to varying numbers of warheads can be inferred for most reasonable arrays. Two

Fig. 55.
Gamma transmission scan of the W53 across the primary region.

3. Future Systems and Other Considerations

Even if one assumes that the inspection system proposed will disclose fully the technology of the inspected system, there are still questions attendant to discussing the significance of this intrusiveness for future systems. Some questions that come to mind are:

- Can one expect any changes in weapons design in the future?
- Are these important to our strategic posture?
- Would USSR adoption of these designs be important to our strategic posture?

Based upon history and some directions of research now under study, it appears that the answer to the first question must be yes. It appears imprudent to assume that progress will halt where it is at present. The hardness and yield-to-weight of U.S. strategic weapons has far from reached the limit of conceivable possibility so that there is room for progress.. What is needed are ideas and work, neither of which will halt but which might be spurred by ratiocination on a foreign design process.

Two examples of future U.S. weapon design changes which would be revealed by application of the inspection equipment relate to advanced [redacted] The existence of such technology would have implications beyond the strategic area. That is, such a breakthrough would have application to the ABM problem and to tactical nuclear weapons.

The answers to the other two questions are not as straightforward. Regarding the importance of changes to our strategic posture, improvements in the basic parameters of warhead design may or may not be important to the U.S., depending upon the strategy for the force employment. [redacted] These are questions that are germane to this problem but are outside the scope of this paper.

It is also difficult to discuss the implications of what we would learn about the USSR technology. It depends greatly upon how accurate our present knowledge is. [redacted] In general, any estimate which now must be based upon intelligence could become more accurate.

Information gained would also be applicable to our warhead design programs, [redacted] if designers were made aware of the data. Even confusing data could generate ideas for new approaches. [redacted] More definitive information could either act as a strong force toward new thinking (if the USSR designs were basically different) or be devoid of such emphasis (if their approaches had already been studied). The situation is sensitive to the USSR state of the art and the similarity of their design approaches to ones that we have already pursued.

F. Conclusions

The prototype inspection equipment was selected judiciously to balance effectiveness against intrusiveness. Interpretation of data obtained with the inspection equipment is an implicit process and is presumably more difficult in proportion to the degree that USSR RV designs differ from those of the U.S. Inspection equipment could be devised that would be more effective and correspondingly more intrusive, or vice versa.

Application of the four subelements now considered requires that sophisticated steps be taken to evade the system if U.S.-type RV designs are assumed, [redacted] Application of the inspection equipment to U.S. strategic systems [redacted] While specific information on vulnerability and hardness would be obtained only poorly from application of the detection system, general levels could be inferred, so that the matter should be weighed carefully.